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A STUDY ON NON-THERMAL PASTEURISATION PROCESS OF SKIMMED MILK THROUGH MICROFILTRATION SYSTEM

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ABSTRACT

In new era, Microfiltration process is widely used in the production of high quality milk. In traditional heat treatment, the microorganisms of the milk are inactivated and the chemical composition of the milk is changed, whereas in microfiltration process it physically removes bacteria and impurities from the milk, leaving practically undesired changes to the chemical composition of milk. The overall values of physiochemical property except protein and phosphatase, no other physiochemical property of micro filtered milk samples was influenced significantly when compared to both control samples. Lowers stability and shelf life was observed in Micro filtered retentate milk sample (MFRM) at both ambient and refrigerated storage when compared to Micro filtered permeate milk sample (MFPM).

KEYWORDS: Microfiltration Process, Permeate Milk, Retentate Milk,& Shelf Life Comparison

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Original Article

INTRODUCTION

Milk is an essential constituent for human race. It is a complex mixture of different compounds like fat, protein, lactose, minerals etc. These components have specific nutritional and functional properties. Fractionation of these compounds will enable pure ingredients to be produced that have advantages of constant quality (Huffman and Harper 1999).

The milk is an ideal liquid for membrane filtration due to its composition. Membrane technology has been applied in the dairy industry since the early 1960s and now comes the second behind the water treatment technology and serves as viable alternatives for more traditional dairy processes. It has become as an alternative to the "Pasterurisation" (Barros et al, 2006). In the present scenario, different types of membrane separation technologies such as microfiltration (MF), ultra filtration (UF), nanofiltration (NF) and reverse osmosis (RO). A feed is introduced to a membrane separation system it is separated into retentate (concentrate) fraction that is retained by membrane, and permeate (filtrate) fraction that passes through the membrane (Thien Trung et al., 2014) are being made available for use in the dairy industry (Rosenberg, M 1995).

The membrane technology is the future possibilities that minimize the adverse effect of temperature rise such as change in phase, denaturation of proteins and change in sensory attributes of the product. The membranes

remove unwanted components viz. microorganisms, drugs or sediments that have a negative impact on product quality, making the final product more attractive in texture and increasing its shelf life. The selectivity of membranes is very high due to the unique mechanisms of action such as ion exchange, solution diffusion and molecular weight cut off etc (Chenchaiah Marella et al, 2013).

Microfiltration is designed to remove particulate matter in the range of 0.1 μm to 10 μm from a fluid medium. Due to this wide size range, MF processes have informally been described in the dairy industry as either large pore or small pore MF. Large pore MF describes the use of membranes with an approximate pore diameter of 1 to 2 μm. By removing bacteria and spores from milk's skim fraction prior to pasteurization, fluid milk with an extended shelf life can be produced (Elwell and Barbano, 2006).

The objective of our study was to investigate the effects and benefits of skimmed milk processed through the micro filtration using membrane technology. Specially to study the microbial challenges and to minimize the loss of nutritive value of products.

MATERIALS AND METHODS

The present study trail was conducted at M/s Dindigul Farm products pvt Ltd, Karuthanaickan Patty Road, Sendurai, Dindigul district, Tamil Nadu. Non-thermal skimmed milk was processed by using membrane technology using micro filtration (15 Kl capacity) with M/s Pall's ceramic membrane (USA) of 1.4 μm pore size. Ceramic membrane is a porous fine ceramic filter which is sintered from Alumina, Titania or Zirconia under ultra high temperature. Ceramic membrane normally has an asymmetrical structure with porous support active membrane layer. Ceramic Membrane always runs at a Cross Flow Filtration mode. The turbid fluid goes through membrane layer inside the single channel or a multi channel at a high velocity. The skimmed milk pass through the membrane layer vertically to permeation, the solid and big molecule is rejected in retentate. The feed fluid is thus clarified, concentrated and purified (Garcera D and Toujas E 2002). In this process, the raw milk was separated into skim milk and cream (Flow chart 1). The resulting skim milk was microfiltered using ceramic membrane with a pore size of 1.4μm at constant transmembrane pressure.

Physicochemical Analysis of Microfiltered Milk Sample

Sensory Evaluation

The nine-point's hedonic rating scale was used to measure the sensory evaluation of microfiltered milk. The control and microfiltered milk samples were served to the semi trained panel, and the members were asked to rate the acceptability of the samples ranging from like extremely to dislike extremely.

Plate Form Test

All the samples were analysed for the Clot on Boiling (COB), heat stability (alcohol), Corrected lactometer reading (CLR), Solid Not Fat (SNF)and pH. The SNF was calculated by formula method andpH was measured using digital pH meter.

Chemical Analysis

All the microfiltered milk samples were analysed for the Protein (Pyne's method), Fat (Gerber method) and Acidity (Titratation method) using the method as described by IS: 1479 (Part II) 1961.

Microbial Analysis

All the samples were analysed for theMethylene blue reduction test (MBRT), standard plate count (SPC), Coliform countand Yeast and mould count by the methods as described in IS: 5550 (2005).

RESULTS AND DISCUSSIONS

Four cycles were tried by non thermal pasteurization of microfiltration processto filter skim milk in both permeate and retentate concentrated milk was collected. Permeate concentrated milk samples was coded asMFPM1, MFPM2,MFPM3, MFPM4 and retentate concentrated milk samples was coded as MFPR1, MFPR2,MFPR3, MFPR4which was compared with raw (Control 1) and pasteurized skimmed milk (Control 2) samples.

Sensory Evaluation of Micro filtered Milk Samples

The quality attributes viz., colour and appearance, flavour, consistency and overall acceptability of MF milk samples were determined by sensory evaluation. Observations given by sensory panel were very important for deciding the quality of the product. The results depicted in table 1 shows that the maximum overall acceptability mean score of 8.25 8.0, 7.315 and 7.0 was awarded for C1, C2, MFPM and MFRM samples respectively. The scores colour and appearance, flavour, consistency and overall acceptability are aligned towards the raw milk and better than pasteurized milk. As there tentate milk sample was scored less in the flavour thereby lowering the sensory scores slightly it might be due to the ceramic membrane used. The results are also shown graphically in figure 1. Rosenberg, M 1995 also reported that resulting of microfiltered milk products have superior quality and sensory characteristics compared to those produced from milk in conventional methods. Bactocatch or MF, in general, can be applied in production of consumption market milk (Elwell and Barbano, 2006).

Physicochemical Analysis of Micro Filtered Milk Samples

The results depicted in the table 2 shows that the mean value of CLR was 30.5, 31.5, 29.31 and 31.68observed for C1, C2, MFPM and MFRM samples respectively. Based on these findings of CLR, it is observed that the frequency difference between the samples has 3.05. It seems that one point variations for CLR between the samples.

In case of acidity (%LA) values, it was observed that the values showed decreased order as the pH level increased. The values 0.156, 0.142, 0.125 and 0.131 observed for C1, C2, MFPM and MFRM samples respectively. However, the average frequency difference between the samples of acidity is 0.014.

The results depicted in the table 2 shows that the mean value of pH was 6.47, 6.55, 6.68 and 6.66 observed for C1, C2, MFPM and MFRM samples respectively. The average frequency difference between the samples of pH is 0.67.The normal pH of milk is about 6.6.

Regarding SNF content of experimental samples was 8.6, 8.5, 7.6 and 8.2 observed for C1, C2, MFPM and MFRM samples respectively. The average frequency difference between the samples of SNF is 0.85.

Based on the results of fat content the entire sample has nil value because of thetype of milk used. The results depicted in the table 2 shows that the mean value of protein was 3.8, 3.3, 3.575 and 3.65 observed for C1, C2, MFPM and MFRM samples respectively. The average frequency difference between the samples of protein is 0.38. While the experimentation, it was observed that the decreased protein level in C2 sample it tends to heat process of pasteurization posses which was lowers the denatured protein content when compared to MF milk samples and C1.

Pasteurization efficiency was checked by phosphotase test. Sample C1 has positive effect. As reported in the trail, microfiltered milk samples of both permeate and retentate concentrate also have negative effect when compared to the sample C2.

Microbial Analysis of Micro Filtered Milk Samples

The results furnished in the table 3 clearly shows that highest time ford is colouring methelyne blue up to 8 hours was taken by microfiltered permeate milk samples(MFPM), whereas Microfiltered retentate milk sample(MFRM) has 6 hours next to the C2 sample (4.5 hours). The sample C1 has the potentiality for oxygen reduction (MBRT) within 2 hours. Thien Trung Le et al,(2014) reported that microfiltration offers an efficient alternative to heat treatment for removal of bacteria from liquid food. Actually, removal of bacteria and spores from skim milk is one of the most important applications of MF in dairy industry. The highest MBRT attained microfiltered milk samples (MFPM / MFRM) was found to have decrease of SPC (cfu/g) values when compared with control samples. Yeast and mould as well as coliform counts were absent in all the samples hence, not reported.

Shelf Life of Micro Filtered Milk Samples

The shelf life of permeate concentrated milk with retentated milk samples were compared. Table 4 shows the respective values of organoleptic test (OT), acidity, COB and heat stability. The results were observed in every 1hourduring the ambient storage period (35±2ºC) . Whereas in refrigeration storage period(3±0.5ºC) the results were observed once in 8 hour and furnished in table 5. The results were also shown graphically in figure 2.

Regarding the shelf life of micro filtered permeate milk samples, the physiochemical ability shown upto 10 hours at ambient storage condition whereas retentate milk samples able to withstand only 9 hours afterwards shown negative effect. In case of shelf life of refrigerated storage condition, both microfiltered permeate milk samples (MFPM) and Micro filteredretentate milk samples (MFRM) based on acidity it is within the specification limit for5 days and on COB micro filtered permeate milk samples (MFPM) with stand around 10 days whereas Microfiltered retentate milk samples (MFRM) withstand around 8.5 days afterwards shown negative effect.

CONCLUSIONS

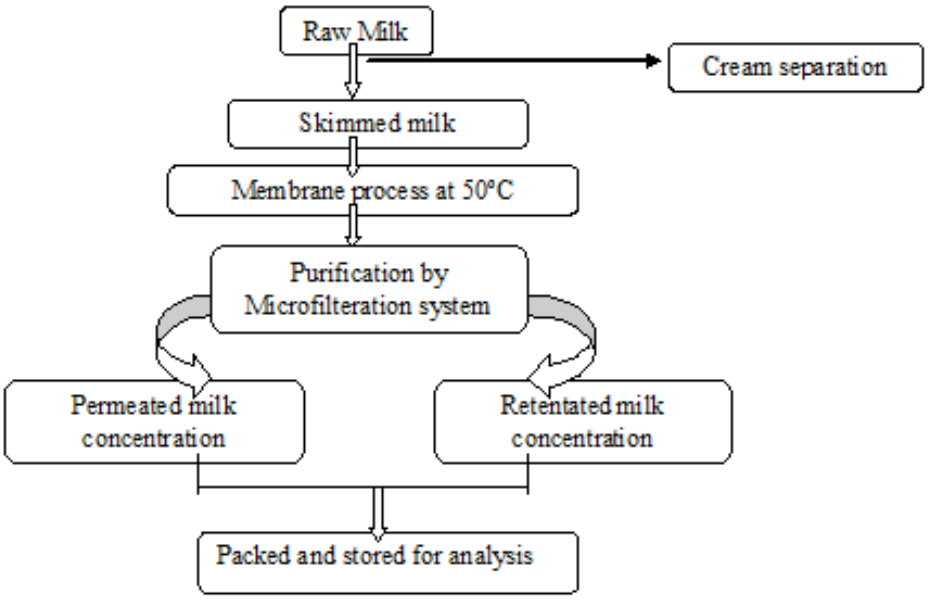
Based on the findings of experimentation, it is concluded that the retentate milk sample was decreased in the flavour score thereby lowering the sensory appeal. The overall values of physiochemical property except protein and phosphatase, no other physiochemical property of micro filtered milk samples was influenced significantly when compared to both control samples. The protein of MFPM compared to the control C2 indicates the advantage of Microfiltration process. Decrease in stability and shelf life time was observed in micro filtered retentate milk sample (MFRM) at both ambient and refrigerated storage when compared to micro filtered permeate milk sample (MFPM). The refrigerated MFPM can be used as an alternative towards a pasteurised skim milk as the shelf life, stability, acidity are at par with control sample C2.

REFERENCES

1. *Barros CMV, Riberiro ACO and Viotto WH (2006) Impact of low concentration factor ultrafiltration on the composition and yield of reduced fat Prato cheese, Desalination, 200: 555-556.*

2. *Chenchaiah Marella, K.Muthukumarappan and L.E. Metzger (2013) Application of membrane separation technology for developing novel dairy food ingredients. J.Food Process Technol 4 (9): 1000269.*
3. *Elwell MW and Barbano DM (2006) Use of microfiltration to improve fluid milk quality. Journal of Dairy science, 89: E20-30.*
4. *Garcera D and Toujas E (2002) Graded permeability macroporous support for cross flow filtration. U.S patent, Editor, Societe des Ceramiques Techniques: France.*
5. *Huffman LM, Harper WJ(1999) Maximizing the value of milk through separation technologies. J Dairy Sci 82: 2238 -44.*
6. *Indian standard: 1479 (Part II) (1961) Chemical analysis of milk. Indian standards Institution, Manak Bhavan, New Delhi.*
7. *Rosenberg, M (1995) Current and future applications of membrane processes in the dairy industry. Trends Food Sci.Tech., 6, 12-19.*
8. *Thien Trung Le, Angeli D. Cabaltica and Van Mien Bui (2014) Membrane separations in dairy processing, J.Food Research and Technol2 (1):01-14.*

APPENDICES



Flow Chart 1: Microfiltration Process of Milk

Table 1

Sl. No	Sample Code	Sample Description
1.	Control 1	Raw milk
2.	Control 2	Pasteurized milk
3.	MFPM1	Microfiltration Permeate milk – Cycle 1
4.	MFPM2	Microfiltration Permeate milk – Cycle 2
5.	MFPM3	Microfiltration Permeate milk – Cycle 3
6.	MFPM4	Microfiltration Permeate milk – Cycle 4
7.	MFRM1	Microfiltration Retentate milk – Cycle 1
8.	MFRM2	Microfiltration Retentate milk – Cycle 2
9.	MFRM3	Microfiltration Retentate milk – Cycle 3
10.	MFRM4	Microfiltration Retentate milk – Cycle 4

Table 2: Sensory Evaluation of Micro filtered Milk Samples

Parameter	C_1	C_2	Permeate				Retentate			
			MFP M_1	MFP M_2	MFP M_3	MFP M_4	MFR M_1	MFR M_2	MFR M_3	MFR M_4
Colour & appearance	8	8	8	7	7	7	7	7	7	7
Flavour	9	8	7	7	6	7	7	7	6	6
Consistency	8	8	8	8	8	8	8	7	8	7
Overall acceptability	8	8	7	8	7	7	7	7	7	7
± SD	8.25	8	7.3125				7.0			

Table 3: Physico Chemical Analysis of Microfiltered Milk Samples

Test	C_1	C_2	Permeate				Retentate				F Value
			MFP M_1	MFP M_2	MFP M_3	MFP M_4	MFR M_1	MFR M_2	MFRM $_3$	MFRM $_4$	
CLR	30.5	31.0	29.75	28.5	28.25	30.5	33.25	28.5	32.5	32.25	3.05
Acidity	0.156	0.142	0.140	0.108	0.117	0.117	0.140	0.126	0.130	0.131	0.014
pH	6.47	6.55	6.59	6.65	6.62	6.60	6.47	6.42	6.41	6.40	0.67
SNF	8.6	8.5	8.27	6.73	7.42	7.98	8.67	7.48	8.48	8.42	0.85
Fat	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Protein	3.8	3.3	3.8	3.5	3.4	3.6	3.8	3.5	3.6	3.7	0.38
Phosphatase	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-

Table 4: Microbial Analysis of Micro Filtered Milk Samples

Test	C_1	C_2	Permeate				Retentate			
			MFP M_1	MFP M_2	MFP M_3	MFP M_4	MFR M_1	MFR M_2	MFR M_3	MFR M_4
MBRT	2.12	4.85	8.15	8.02	7.95	8.12	6.12	6.08	6.21	6.50
Coliform	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
E.Coli	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SPC(cfu/g)	8	4	3	2	2	3	4	4	5	4

Table 5: Shelf Life of Micro filtered Milk Samples at Ambient Storage Condition (35±2ºc)

Time/H	OT		Acidity		COB		Alcohol (65%)	
	Permeate	Retentate	Perm	Reten	Perm	Reten	Perm	Reten
00.5	Normal	Normal	0.140	0.144	-ve	-ve	-ve	-ve
08.00	Normal	Normal	0.140	0.144	-ve	-ve	-ve	-ve
09.00	Normal	Normal	0.140	0.144	-ve	-ve	-ve	-ve
10.00	Normal	Normal	0.144	0.148	-ve	-ve	-ve	-ve
11.00	Stale	Stale	0.148	0.171	-ve	+ve	-ve	+ve
12.00	Sour	Sour	0.153	0.182	+ve	+ve	+ve	+ve

Table 6: Table 6: Shelf Life of Micro Filtered Milk Samples at Refrigeration Storage Condition (3±0.5ºC)

Date	Time	OT		Acidity		COB		Alcohol (65%)	
		Permeate	Retentate	Perm	Reten	Perm	Reten	Perm	Reten
1st day	6.00am	Normal	Normal	0.140	0.135	-ve	-ve	-ve	-ve
	2.00pm	Normal	Normal	0.140	0.135	-ve	-ve	-ve	-ve
	10.00pm	Normal	Normal	0.140	0.135	-ve	-ve	-ve	-ve
2nd day	6.00am	Normal	Normal	0.140	0.135	-ve	-ve	-ve	-ve
	2.00pm	Normal	Normal	0.140	0.135	-ve	-ve	-ve	-ve
	10.00pm	Normal	Normal	0.140	0.140	-ve	-ve	-ve	-ve
3rd day	6.00am	Normal	Normal	0.140	0.140	-ve	-ve	-ve	-ve
	2.00pm	Normal	Normal	0.140	0.140	-ve	-ve	-ve	-ve
	10.00pm	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve

Table 6: Contd.,									
4th day	6.00am	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
	2.00pm	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
	10.00pm	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
5th day	6.00am	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
	2.00pm	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
	10.00pm	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
6th day	6.00am	Stale	Stale	0.140	0.140	-ve	-ve	-ve	-ve
	2.00pm	Stale	Stale	0.108	0.108	-ve	-ve	-ve	-ve
	10.00pm	Stale	Stale	0.108	0.108	-ve	-ve	-ve	-ve
7th day	6.00am	Stale	Stale	0.108	0.108	-ve	-ve	-ve	-ve
	2.00pm	Stale	Stale	0.099	0.108	-ve	-ve	-ve	-ve
	10.00pm	Stale	Stale	0.099	0.108	-ve	-ve	-ve	-ve
8th day	6.00am	Stale	Stale	0.099	0.108	-ve	-ve	-ve	-ve
	2.00pm	Stale	Stale	0.099	0.108	-ve	-ve	-ve	-ve
	10.00pm	Stale	Stale	0.099	0.108	-ve	-ve	-ve	-ve
9th day	6.00am	Stale	Stale	0.099	0.126	-ve	-ve	-ve	-ve
	2.00pm	Stale	Stale	0 .108	0.140	-ve	-ve	-ve	-ve
	10.00pm	Stale	Sour	0.126	0.193	-ve	**+ve**	-ve	**+ve**
10th day	6.00am	Stale	Sour	0.144	0.225	-ve	**+ve**	-ve	**+ve**
	2.00pm	Stale	Sour	0.146	0.225	-ve	**+ve**	-ve	**+ve**
	10.00pm	Sour	Sour	0.168	0.225	**+ve**	**+ve**	**+ve**	**+ve**

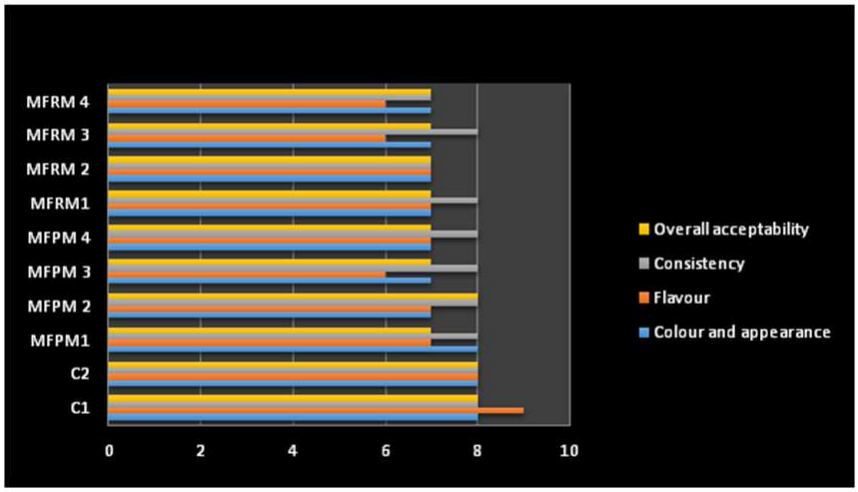


Figure 1: Sensory Evalution of Micrfilterd Milk Samples

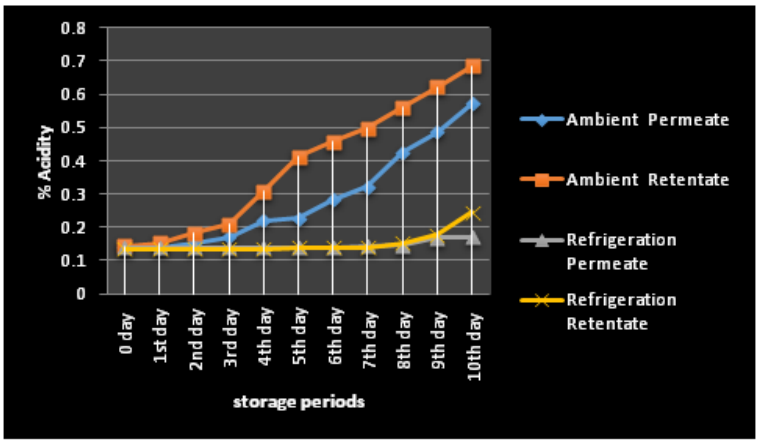


Figure 2: Shelf Life of Micro filtered Milk Samples at Different Storage Conditions